The effects of solar activity on the Global Atmospheric Electrical Circuit

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The global electric circuit (GEC) links the electric field and current flowing in the lower atmosphere, ionosphere and magnetosphere forming a giant spherical condenser, which is charged by the thunderstorms to a potential of several hundred thousand volts (Roble and Tzur, 1986) and drives vertical current through the atmosphere's columnar resistance. Monitoring and researching the global electric circuit (GEC) are crucially important due to its links with climate change. Those two phenomena are connected by lightning activity, which itself is a measure of the GEC. It is known that space weather affects the Earth's lightning activity, therefore the GEC might prove to be a critical tool in examining changing climate in terms of solar and lightning activity.

The possible relation between solar activity and lightning activity has been studied for a long period of time. The relation between sunspot number and lightning activity has been investigated, although the results still remain inconclusive across regions and time. At some regions a positive correlation is found, at others a negative one. Thus, it is important to explore other solar-geomagnetic variables possibly influencing lightning activity, such as geomagnetic index or fast solar wind streams, which were found to correlate well with lightning activity (Scott et al, 2014). Another increasingly important question is whether or not aerosols will contribute significantly to the Earth's radiation budget, whether it be cooling or warming the climate. In a warming climate aerosol loading could alter and increase lightning activity, which in turn can lead to a positive feedback due to generation of NOx and thus O3 in the troposphere, a potent greenhouse gas.

In this project we will look at the connection between solar activity, aerosol loading, and thunderstorm activity in different types of regions such as coastal, boreal forest and urban area first in Finland and later on globally.

- Aniol, R., 1952. Schwankungen der Gewitterha
